

THE CALIBRATION OF PHOTOGRAPHIC AND SPECTROSCOPIC FILMS

(NASA-CR-177830) THE CALIBRATION OF
ELECTROGRAPHIC AND SPECTROSCOPIC FILMS: THE
RESPONSE OF 2ao FILM TO SMALL DOSES OF
ALPHA PARTICLES FROM 3/10TH'S RAD TO 8 RADS
AT ENERGY LEVELS 153 KeV, 79 KeV AND 47 KeV

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The Response of IIaO Film to Small Dosages of Alpha Particles from 3/10th's rad to 8 rads at energy levels 153 mev, 79 mev, and 47 mev.

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**The Response of IIA0 Film to Small Dosages of Alpha
Particles from 3/10th's rad to 8 rads at energy levels
153 mev, 79 mev, and 47 mev.**

ABSTRACT

Pre-exposing IIA0 film to a series of neutral density filters which upon development under standard conditions will produce the standard H-D curve for that film, which were exposed to Alpha particles with a dose range of 3/10th rads to 8 rads while varying the energy of the particles using 153 mev, 70 mev, and 47 mev respectively. An analysis of the film shows that the 3/10th rad dose produces the lowest optical density changes at 70 mev, and 47 mev. While the optical density readings for the darker patterns seem to oscillate and decrease when exposed to radiation dosages of 3/10th rads to 8 rads.

INTRODUCTION

With the utilization of special UV films on the Space LAB Mission and future UIT Missions of the Space Shuttle, it is important to understand the response of these emulsions to the environment of space where there exist particles in the solar wind, the ionosphere surrounding the earth and more energetic particles from the cosmos in general. It is a requirement to have some terrestrial analysis and calibration of that film after exposure to carefully controlled alpha particles using the Harvard University Cyclotron.

The film was pre-exposed using a sensitometer with a number 328 General Electric Lamp at 195 ma current. The sensitometer bulb

was given a 10-18 hour calibration burn-in time. The exposure time for each individual slide or wedge was ten seconds.

EXPERIMENTAL SET UP

The exposed IIaO film was incapsulated in a light-tight aluminum canister for placement in front of the portal of the Harvard University Cyclotron. Special consideration was raised concerning a light-tight portal so that the film would not have to be covered by aluminum foil as it was ultimately so incapsulated. The development of the film occurred immediately after the film canister had been exposed with the appropriate dose and pre-determined calibration of the machine.

RESULTS

The total increase as per change in energy for certain obscurely chosen densities indicates that the higher energy particles for the same dose produce higher optical densities. While the perceptible difference between 79 mev and 47 mev is about the same. Therefore, a reduction in energy for the same dose will reduce the optical density reading on the film.

An examination of optical density versus the dosage for each of the energies: 153 mev, 79 mev, and 47 mev, indicates how the film responds to a very low level dose. It indicates that there is a slight increase in the density of the film for the higher energy dose at 3/10th of a rad. Figures #4, 5, and 6, clearly show a slower increase in the optical densities for dosages of 3/10 rad to 7 rads. Pattern number 8 for each of the energies: 153 mev, 79 mev, and 47 mev, tend to increase in densities, while pattern number 14 displays some decrease and at best some oscillatory

activity as the rad dosage increases. And, finally, an examination of the most dense wedge at the energies at 153 mev, 79 mev, and 47 mev, clearly show a decrease in optical densities with respect to the 79 mev and 47 mev runs. This observation is consistent for all of the data.

DISCUSSION

The interaction between the rad dosage and the individual energies of the alpha particles is a very complex phenomenon. But the data does indicate the relative limits of very low doses of alpha particles and it clearly demonstrates that the film is sensitive to subtle changes to energy and dosages. Using a 47 mev proton alpha particle and a difference of a 3/10 rad and 6/10 rad exposure there exists a ten percent increase in density. While an examination of 153 mev alpha particles for the same dosage difference produces an eleven percent increase in the optical density in the film. Further examination of the data will reveal other anomalies and particularities of the mix of proton energy rad dosage and optical density.

EXPOSURE EFFECTS FOR DOSAGES BETWEEN .3 RAD AND 6 RADS FOR 47, 79, AND
153 MEV'S RESPECTIVELY.

EXAMINATION OF THE FIRST 12 PATTERNS FOR VERY SMALL RAD DOSAGE CLEARLY INDICATES THAT THE SMALLER DIFFERENCES OCCUR IN THE PATTERNS FROM 3/10 OF A RAD TO 2 RADS TENDS TO INDICATE FOR EACH PATTERN EXAMINED AFTER 2 RADS, THERE IS A SUBSTANTIAL INCREASE IN THE OPTICAL DENSITY AS RELATED TO EACH PATTERN. ONE CAN SEE A SLIGHT SHIFT IN THE OPTICAL DENSITY AT 153 MEV'S WHILE THERE IS A PROPORTIONAL SHIFT FOR THE REMAINING PATTERNS AT EACH RESPECTIVE DATA.

153 MeV

fig. 1

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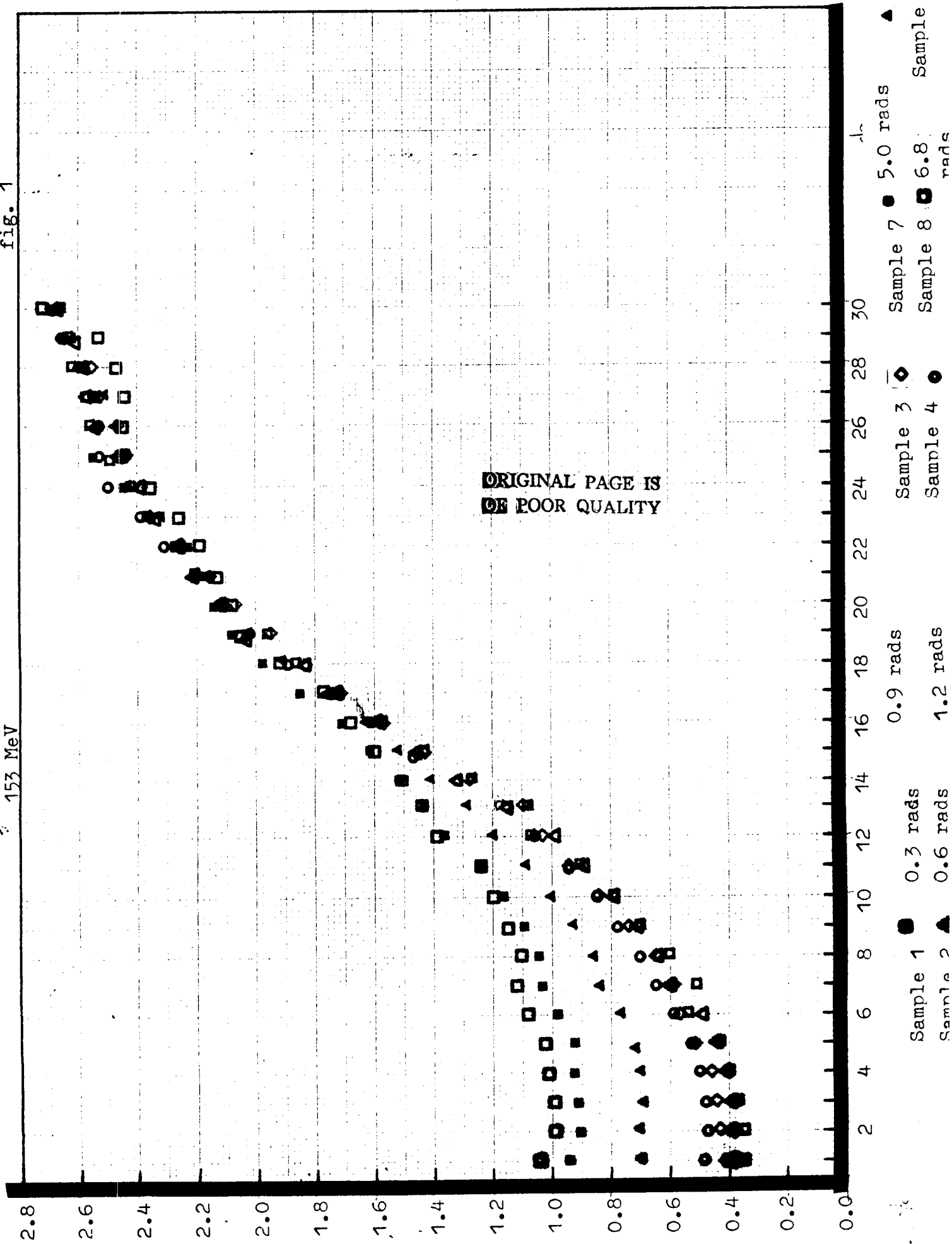
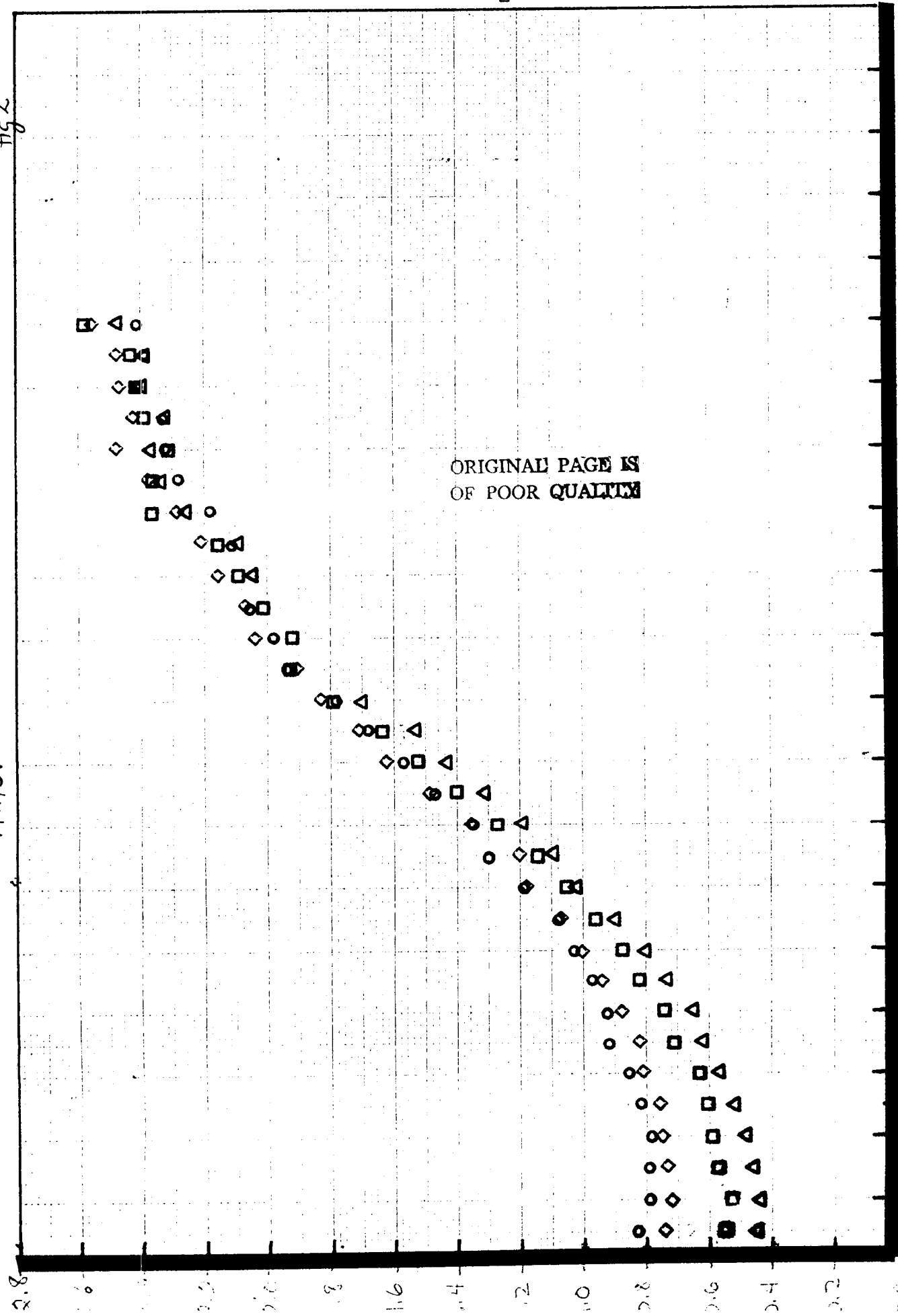


fig 2

79 MeV

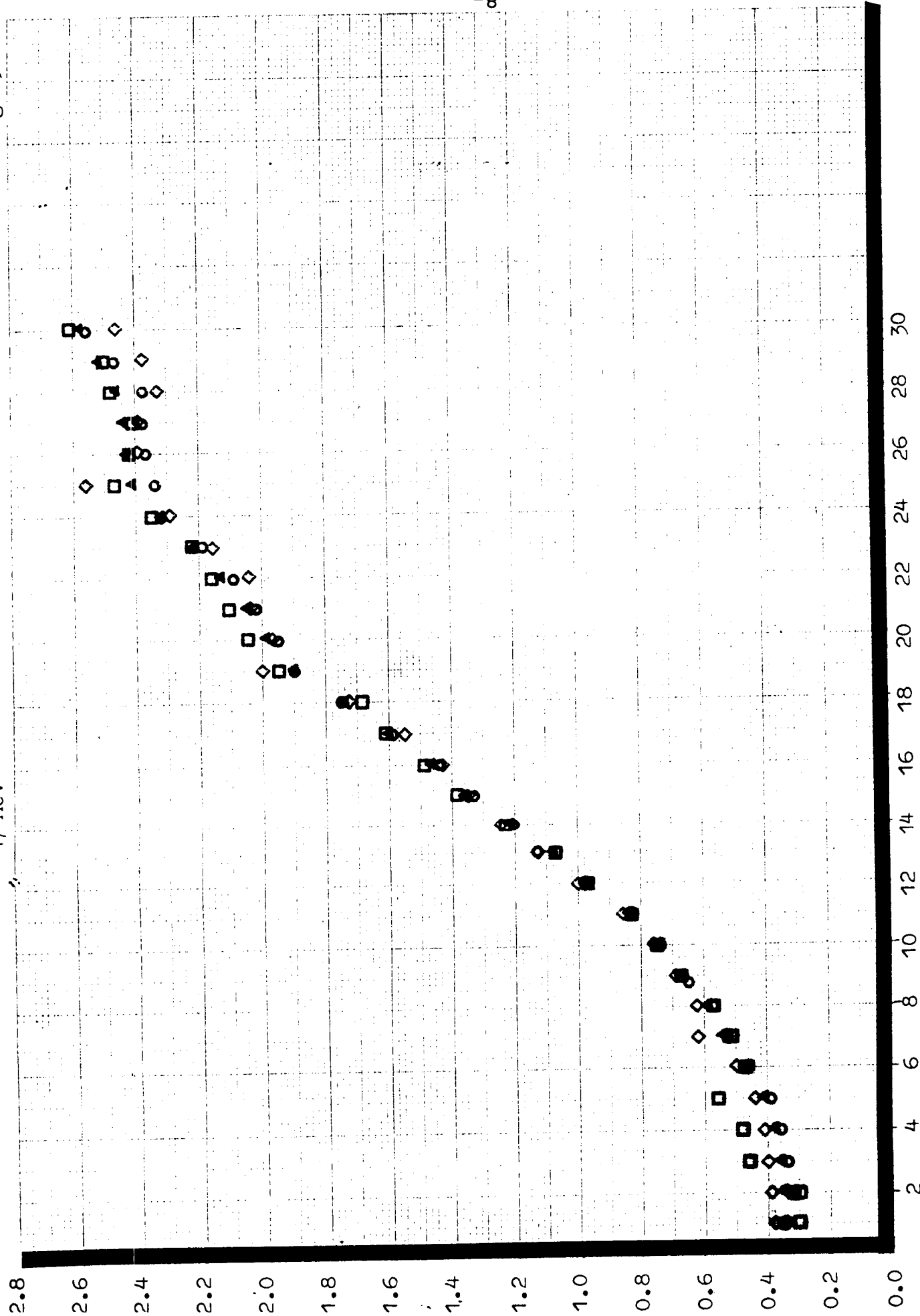


2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
2.85 rads 4.84 rads 6.56 rads

fig. 3

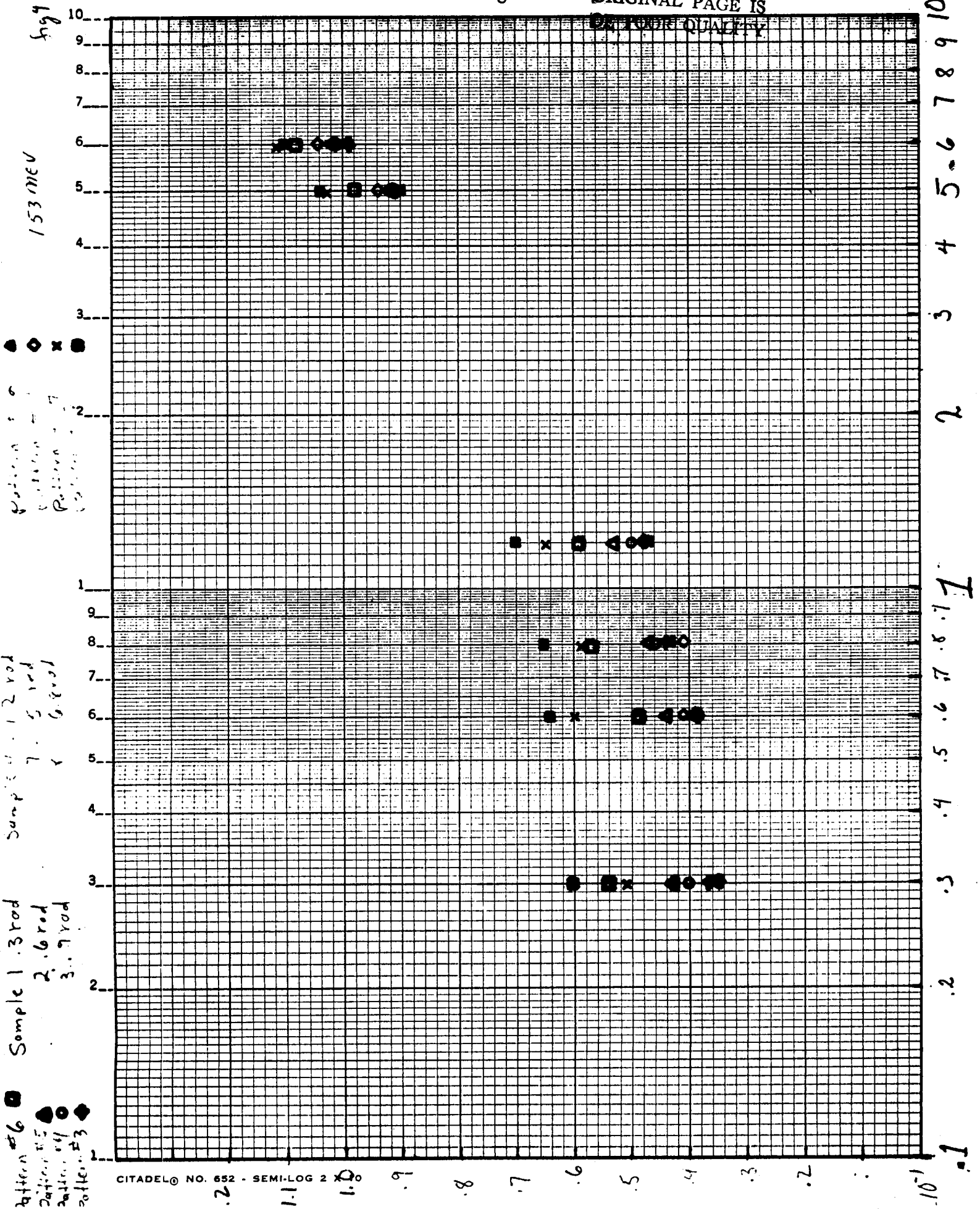
47 MeV

-8-



Sample 21 0.29 rads Sample 23 0.88 rads
Sample 22 0.59 rads Sample 24 1.18 rads

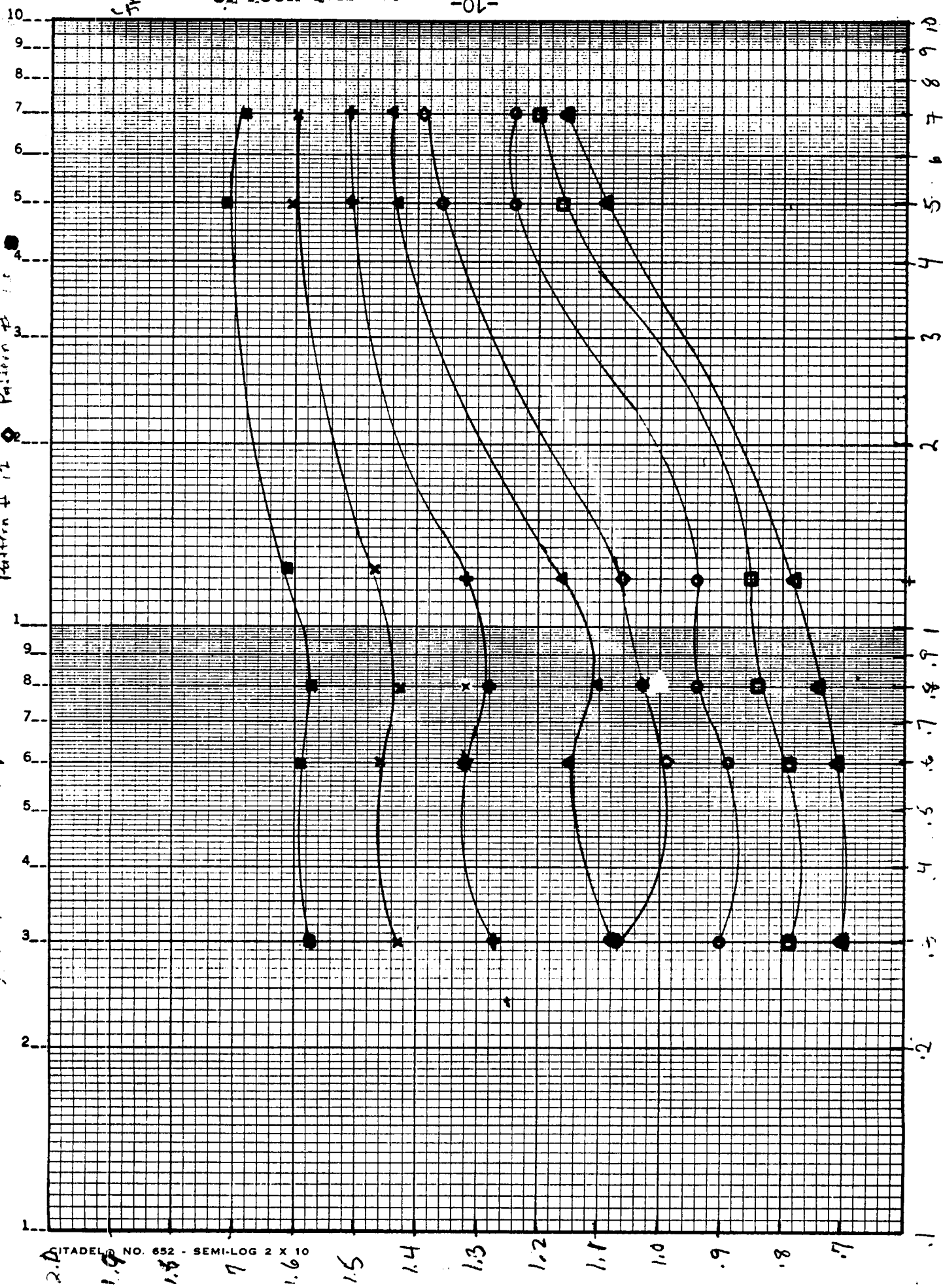
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153 MEJ
Sample 1, 3 rod
2, 6 rod
3, 9 rod
4, 12 rod
5, 5 rod
6, 6 rod

Pattern # 7
Pattern # 9
Pattern # 10
Pattern # 11
Pattern # 12
Pattern # 13
Pattern # 14
Pattern # 15
Pattern # 16



153mmE V

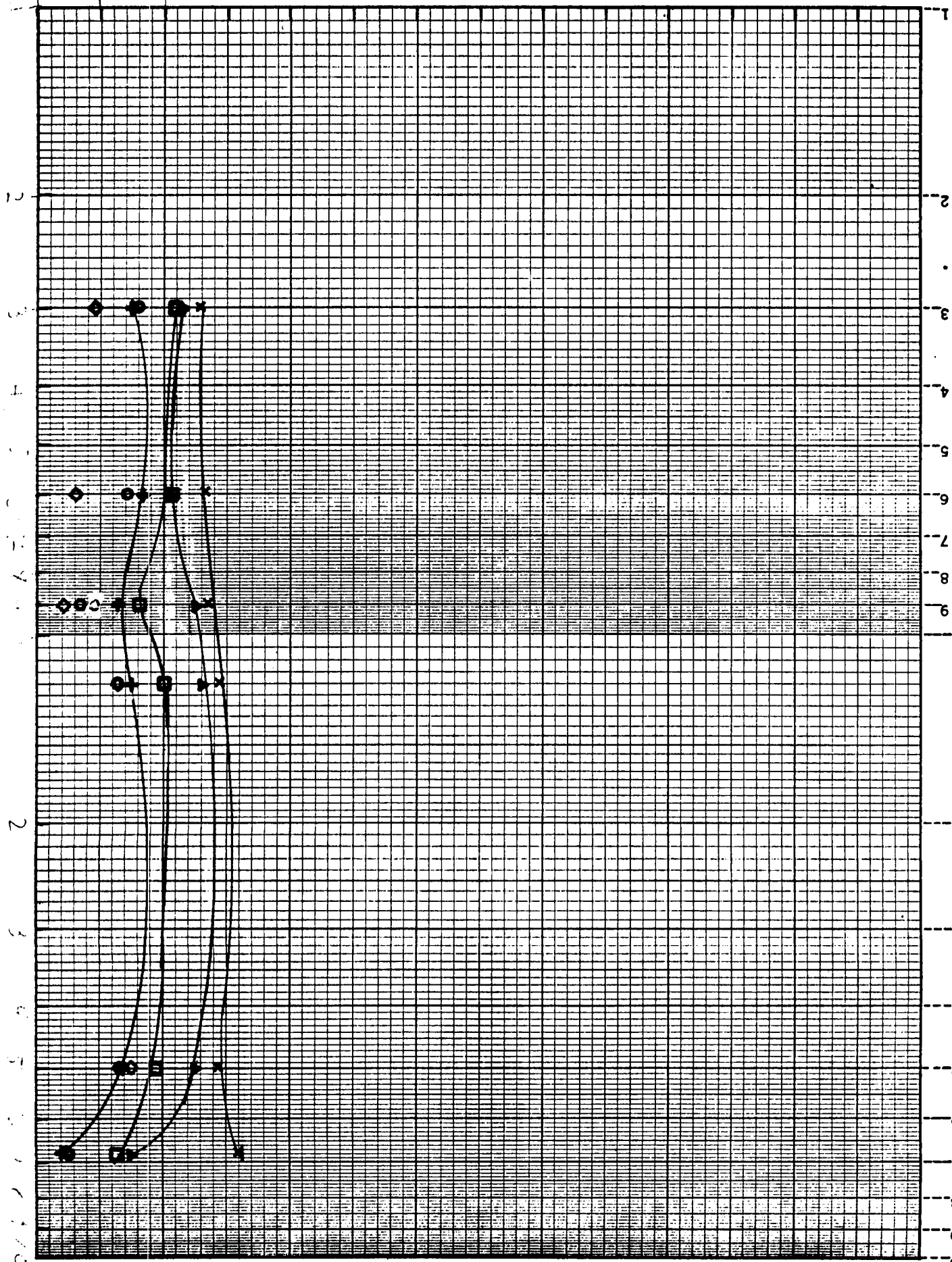
Pattern 225
 1. 1000 2000
 2. 1000 2000
 3. 1000 2000

1. 1000 2000
 2. 1000 2000
 3. 1000 2000
 4. 1000 2000
 5. 1000 2000
 6. 1000 2000
 7. 1000 2000
 8. 1000 2000
 9. 1000 2000
 10. 1000 2000

1. 1000 2000
 2. 1000 2000
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 4. 1000 2000
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2.4
 2.5
 2.6
 2.7



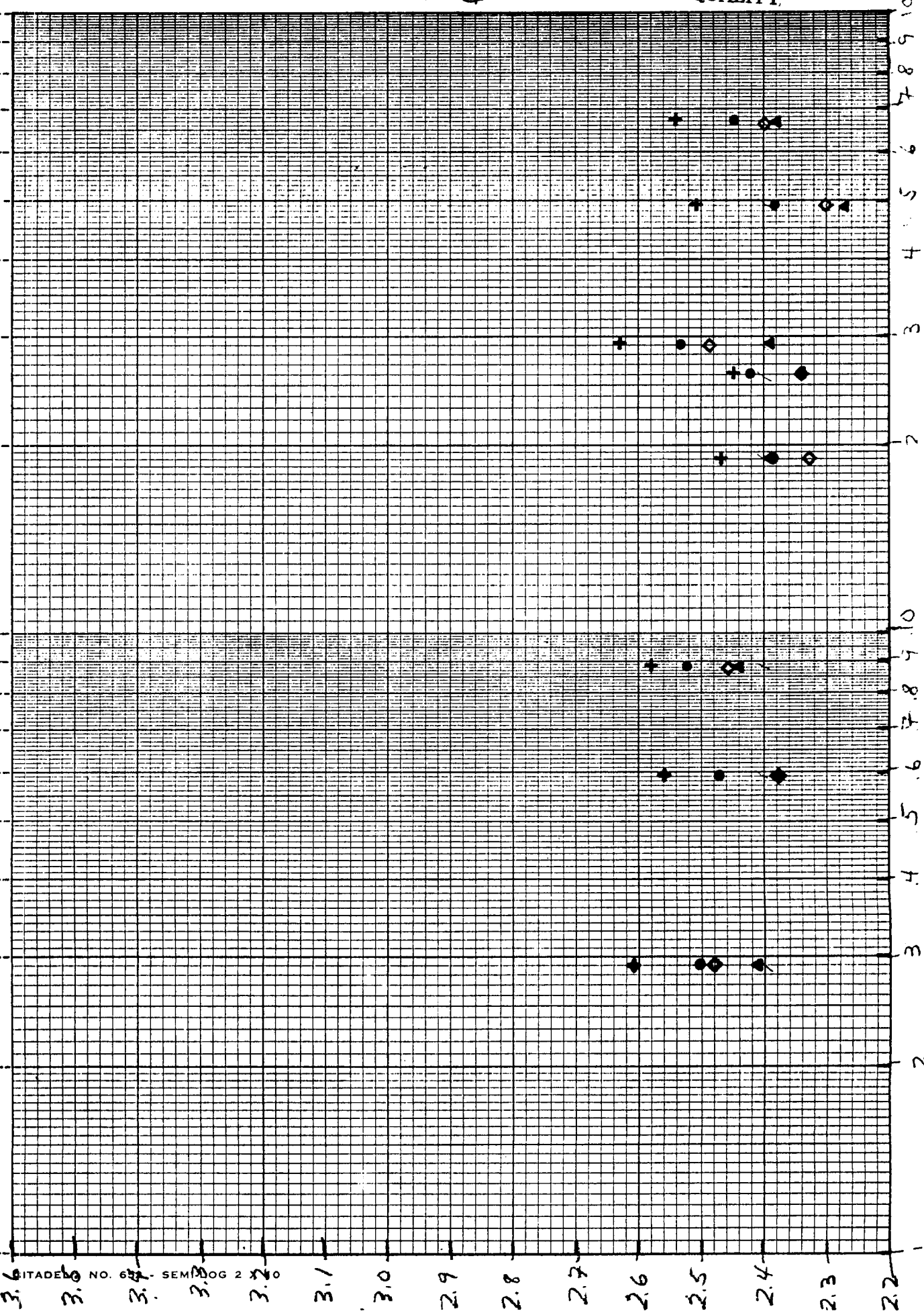
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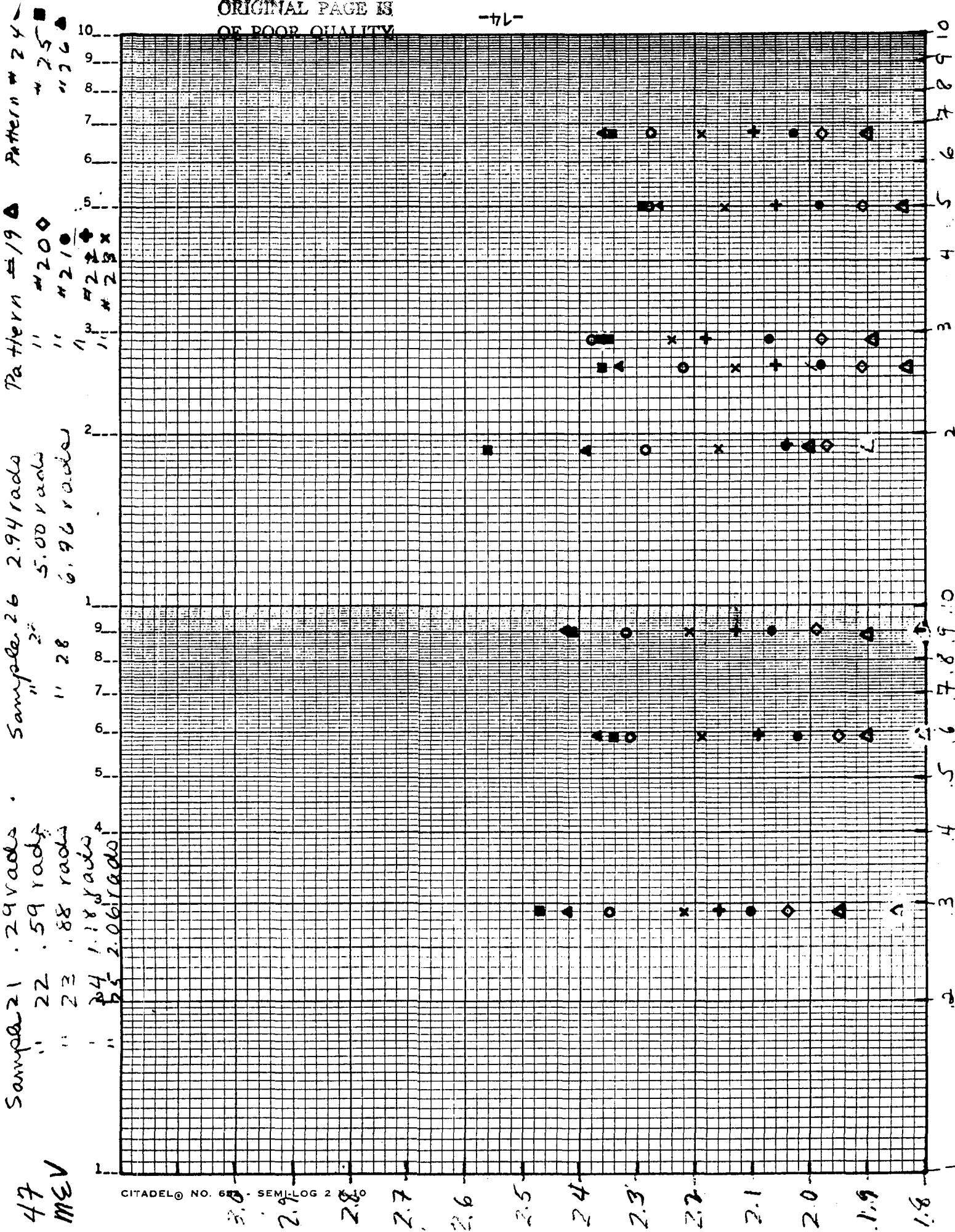
47
mV

Sample	21	22	23	24	25	26	27	28	29	30
radi	29	59	88	18	04	06	00	00	00	00
radi	00	00	00	00	00	00	00	00	00	00
radi	00	00	00	00	00	00	00	00	00	00
radi	00	00	00	00	00	00	00	00	00	00



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Pattern #10 \blacktriangle Pattern #15 \times
 Pattern #11 \blacksquare Pattern #16 \blacktriangle
 Pattern #12 \circ Pattern #17 \bullet
 Pattern #13 \square Pattern #18 \diamond
 Pattern #14 \clubsuit

Sample 21 29 rad
 " 22 59 rad
 " 23 88 rad
 " 24 118 rad
 " 25 206 rad

Sample 26 2.94 rad
 " 27 5.00 rad
 " 28 6.76 rad
 47 MEV

CITADEL® NO. 60 SEMUDOG 2 X NO

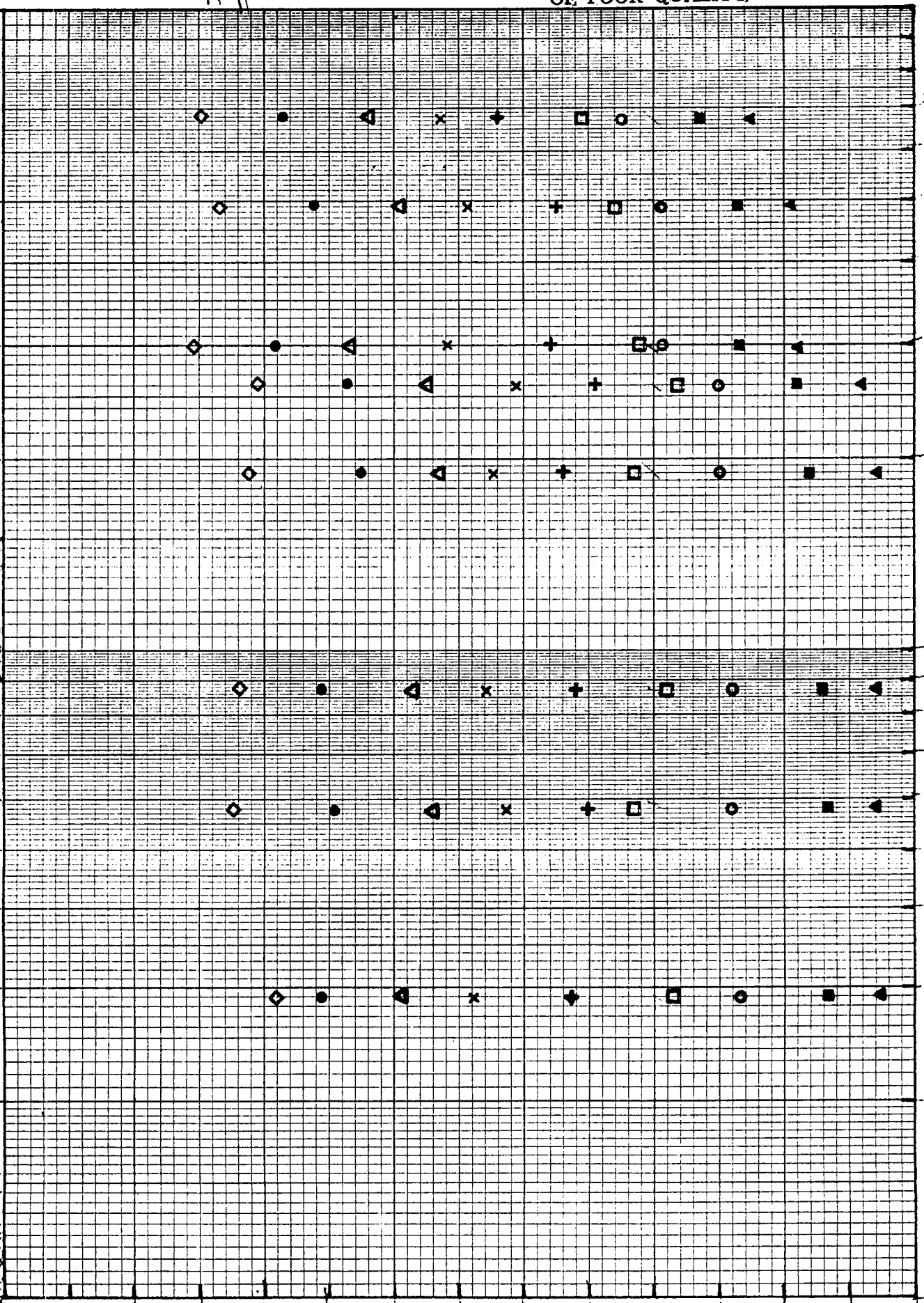
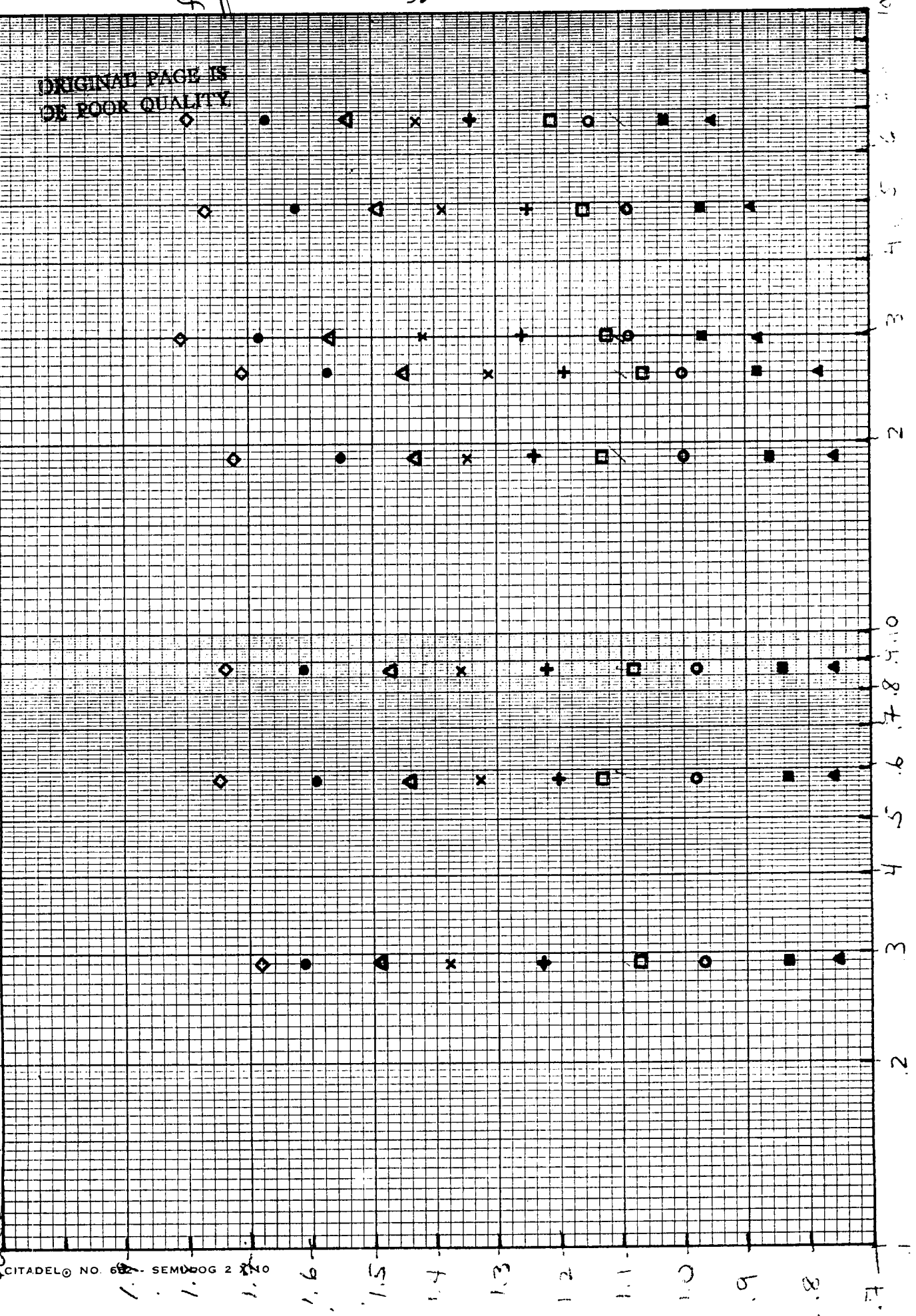


fig 9

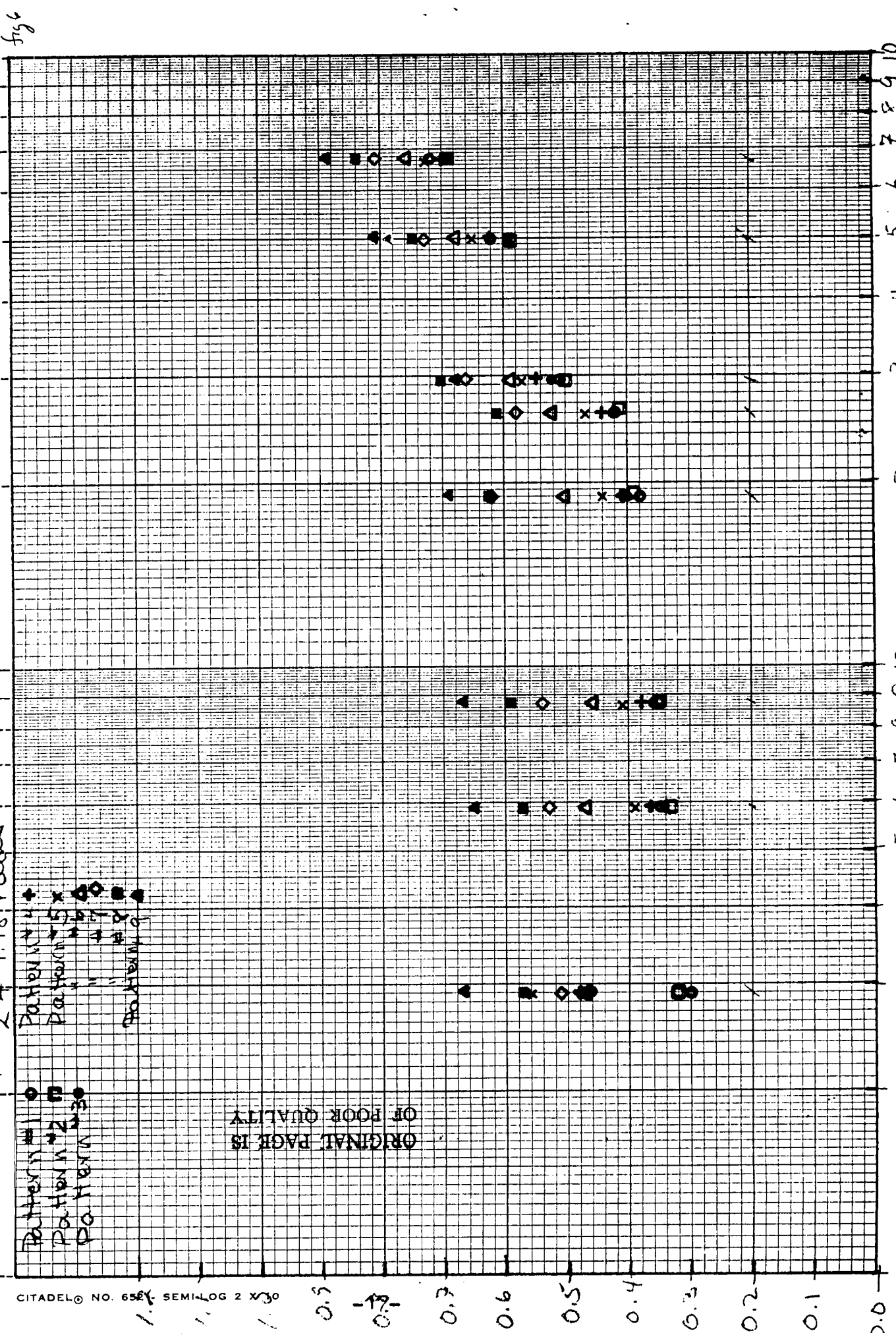
Pattern #10 \blacktriangle Pattern #15 \times
 Pattern #11 \blacksquare Pattern #16 \blacklozenge
 Pattern #12 \circ Pattern #17 \bullet
 Pattern #13 \square Pattern #18 \diamond
 Pattern #14 \oplus

Sample 21 2.9 rads
 " 27 5.5 rads
 " 23 8.8 rads
 " 34 1.8 rads
 " 11 2.06 rads

Sample 26 2.94 rads
 " 24 5.02 rads
 " 28 6.76 rads
 47mEV



47 mEV
 Sample 21 2.29 rad 2.5 2.06 rad
 " 22 2.59 rad 2.6 2.94 rad
 " 23 2.88 rad 2.7 5.00 rad
 " 24 1.18 rad 2.8 6.76 rad

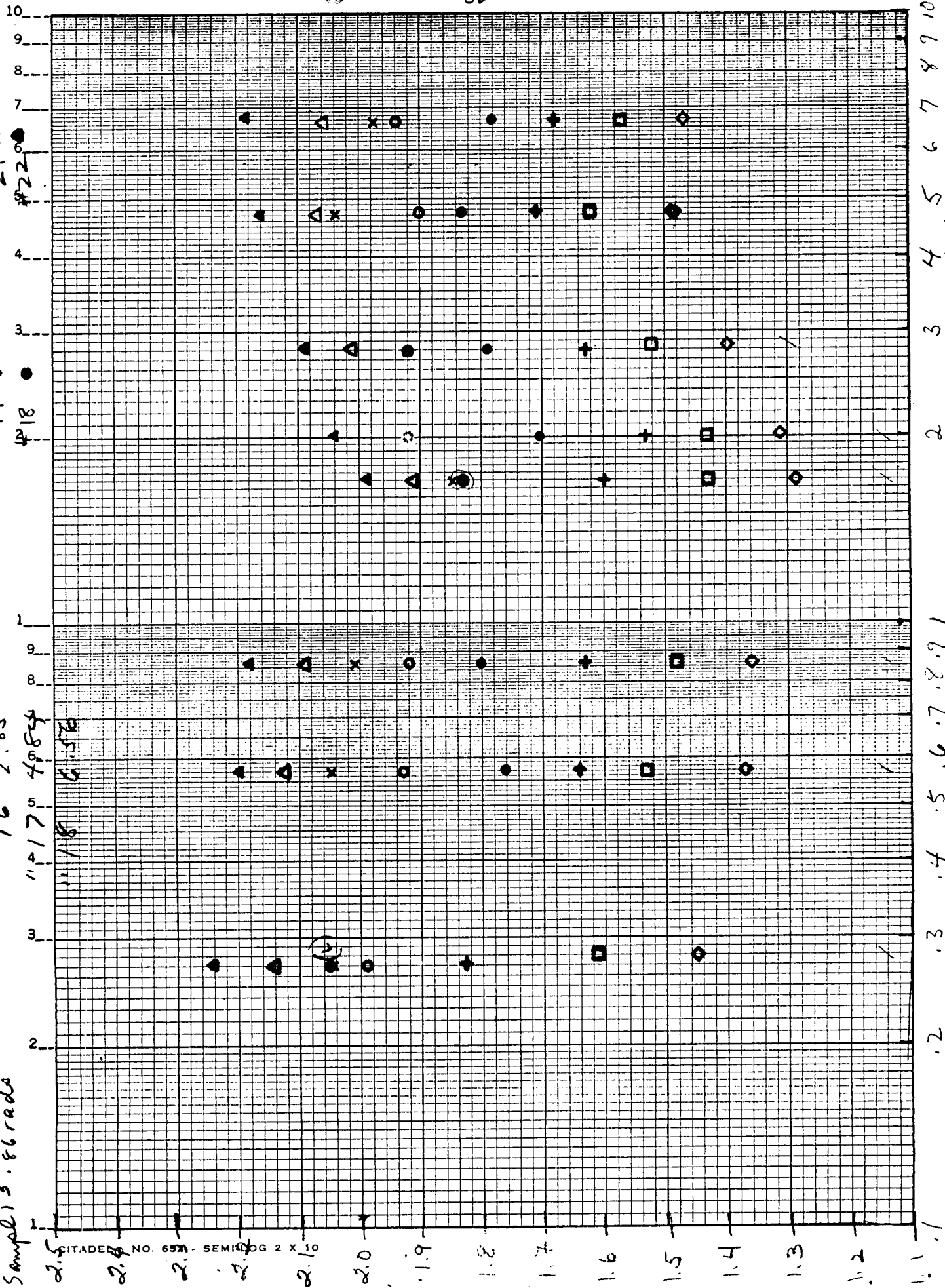


Sample 11 .28 rads
 Sample 12 .57 rads
 Sample 13 .86 rads

Sample 14 1.14 rads
 " 15 2.00 "
 " 16 2.85 "
 " 17 4.98 "
 " 18 6.57 "

Pattern 11 #15
 #16
 #17
 #18

79MEV



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Sample 11
1.28 rads

Sample 13
1.86 rads

Sample 15
2.00 rads

Sample 16
2.65 rads

Sample 17
4.84 rads

Sample 18
6.56 rads

Pattern 11 #12

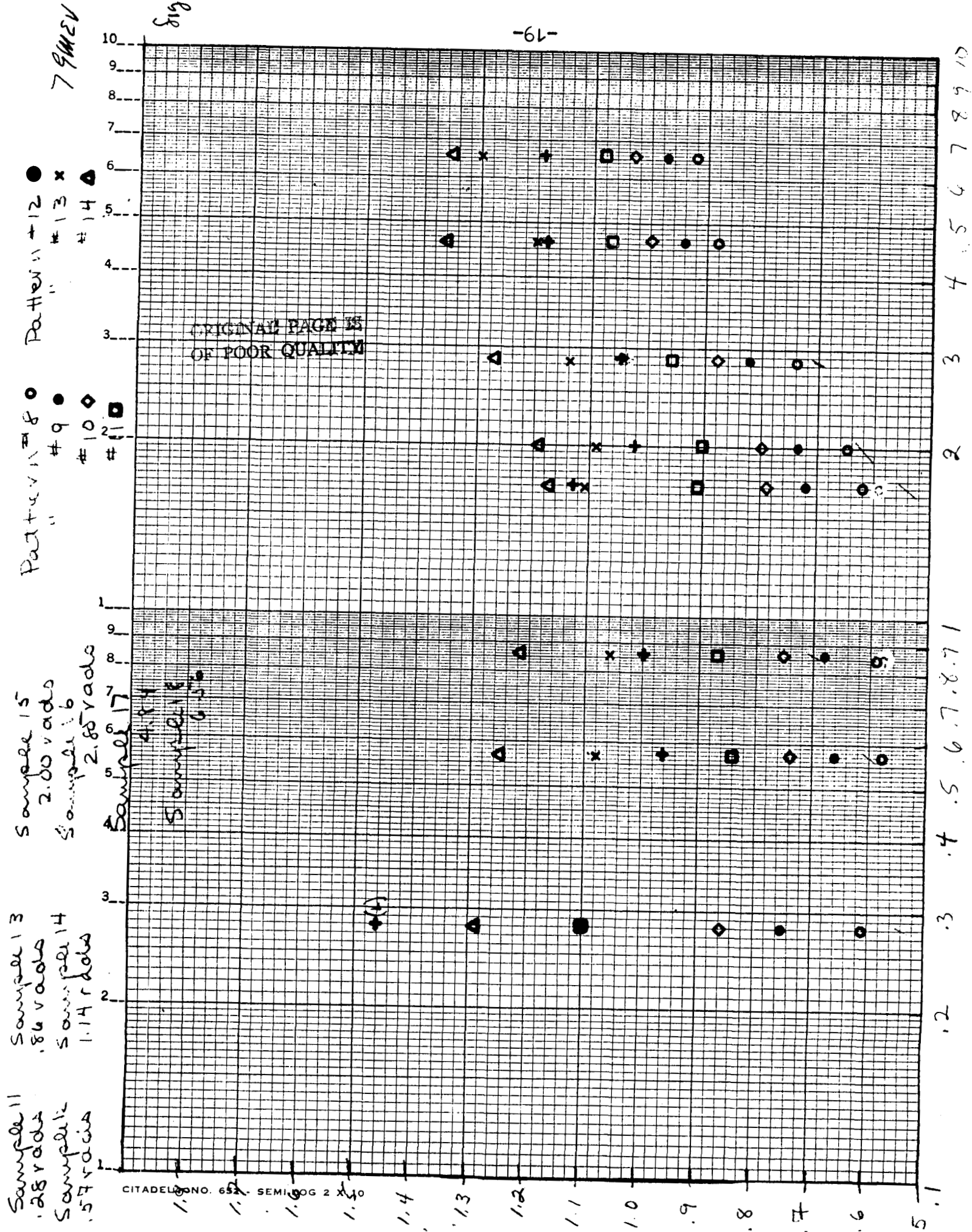
Pattern 11 #13

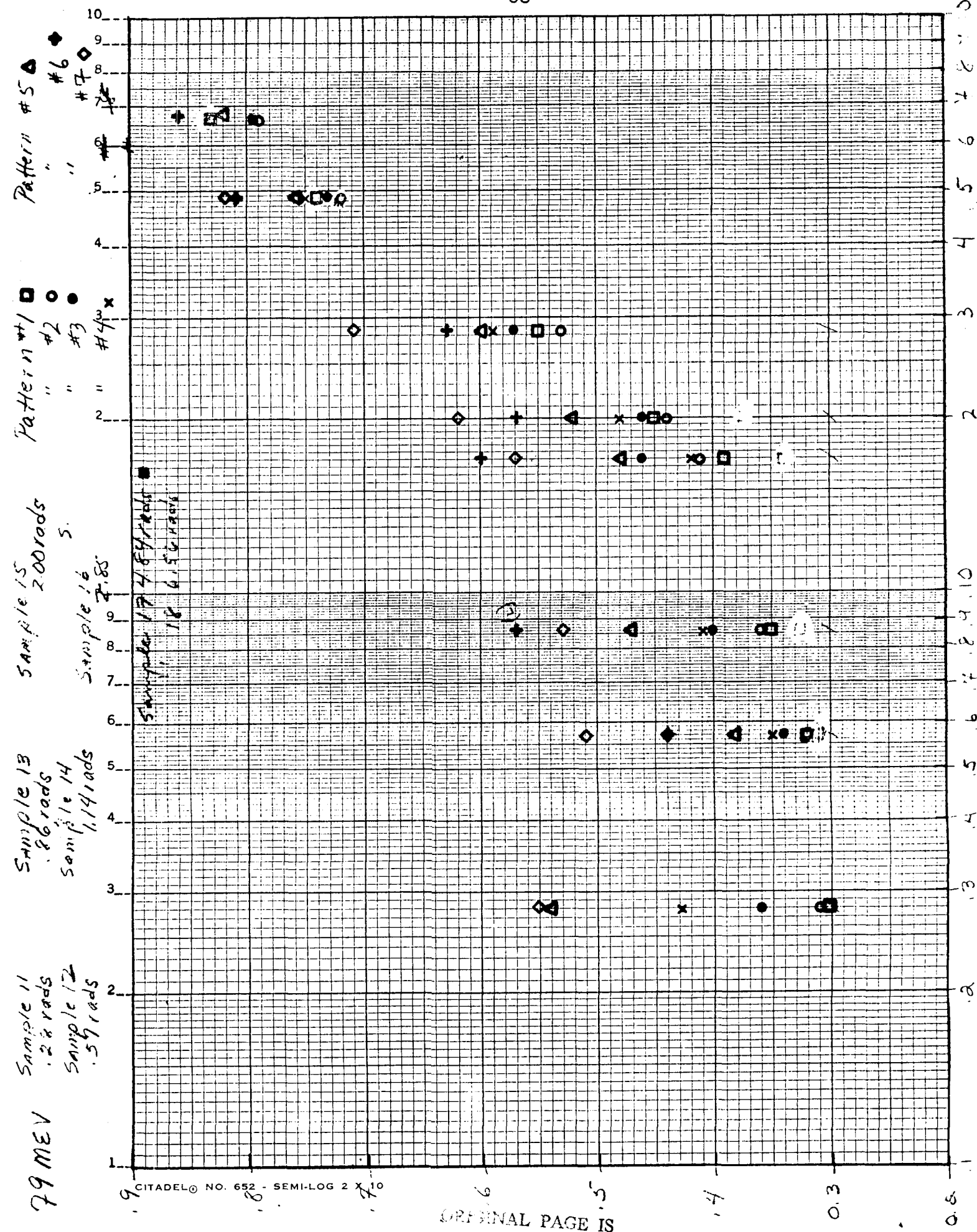
Pattern 11 #14

Pattern 11 #15

Pattern 11 #16

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Fig 5

Patterns = 1
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